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Procedia Engineering 63 (2013) 829 – 834
Procedia Engineering
www.elsevier.com/locate/procedia

The Manufacturing Engineering Society International Conference, MESIC 2013

Study to determinate the feasibility of RFID to facilitate traceability in a logistics operator.

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Abstract

In this paper we present the pilot project on the implementation of an RFID system in the facilities of Carreras Logistics Group, located at PLAZA. The main idea of this research was to determine the accuracy of the measurements obtained in a loading dock by contrasting it with the known information of the goods transported.
Various tests were developed not only to determine the accuracy of RFID technology but also to know the best arrangement between the product and the tag.

Selection and peer-review under responsibility of Universidad de Zaragoza, Dpto Ing Diseño y Fabricacion

Keywords: Logistics; RFID; pilot project; measuring accuracy.

1. Introduction

The Radio Frequency Identification, also known as RFID, is a two-way automatic identification technology between tags and antennas, as shown in Figure 1, via radio waves, so it does not require contact or line of sight Runxian et al. (2005). The RFID has been taken as an important application in operations both of logistics as of the Supply Chain Angeles (2005) however, even though this technology is being used more and more frequently, its application is not exempt from obstacles Zhu (2012) being the three most important challenges of this: i) The effects generated by various materials in the antennas, ii) The collision caused by simultaneous radio transmission and iii) The impact of the orientation between the tag and the antennas on the reception Wu (2006).

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Selection and peer-review under responsibility of Universidad de Zaragoza, Dpto Ing Diseño y Fabricacion
doi:10.1016/j.proeng.2013.08.271

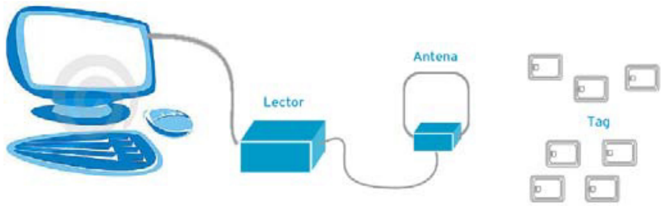

Fig 1. RFID technology.

The literature on RFID is very wide and varied as it reflects how this technology has been applied in many areas of human activity, only in logistics management and supply chain administration there are many examples of how radio frequency identification has been used in various activities within logistics operators, being proof jobs like Mingxiu et al. (2012), where they make a detailed analysis of the advantages and disadvantages of the application of RFID in so-called 3PLs (third party logistics), or the one of Prasanna and M. Hemalatha (2012) who studied how this technology can be very useful in load balancing within the trucks.

Other authors such as Lee and Chan (2009) have studied the RFID as a valuable tool for managing reverse logistics and Yang et al. have analyzed the application of this type of automatic identification in cases of humanitarian logistics Yang et al. (2011). A complete review of the various applications of RFID in operations related with logistics and the Supply Chain Administration can be found in the work of Sarac et al. (2012).

It is in this context that this paper was developed and seeks to provide more information about whether this automatic identification technology has now the necessary and sufficient benefits to be implemented globally in logistics environments, particularly in areas of traceability, which are fundamental for the various links that integrate the Supply Chain. While efforts were made to respond to the quality of the measurements obtained through the conducted experiments, values obtained were analyzed in order to establish the optimum position to place the tag on the products.

2. The experiment design

The tests were conducted at the facilities of Carreras Logistics Group (Transport Division) located in the logistics platform PLAZA (Messina 2, Zaragoza, Spain).

For the development of the experiments established was required to use an aluminum arc, own design and manufacture, with the following dimensions: Height 2,30m, width 2,25m and depth 0,75m, as well as the equipment detailed in Table 1.

Table 1. Equipment used

Equipment	Quantity	Characteristics
Intermec Middelware IF30 model	1	For readings: Ultra High Frequency (UHF)
Intermec antennas IA39B model	3	For readings: UHF
Intermec tags GEN2	100	Type: Passive. For readings: UHF
Zebra printer RZ400	1	For codification: UHF
Reading software	1	Developed by ZLC Log.iD Lab for this job.

The experiments consisted of passing through the arch, which contained RFID-UHF antennas both at the sides as on top, an electric wheelbarrow with various products wrapped in polypropylene, to which they had included a tag in each of the faces with the description of the goods to be transported, as can be seen in Figure 2.

The tests carried out under this scheme were aimed to provide information to determine a) How does the arrangement of tags and antennas affects in the quality and distance of the measure, and b) How the characteristics of the products transported affect the detection of tags, with special emphasis regarding metals and liquids.

Were selected twelve pallets each with different products to perform the tests, which were repeated a total of ten times for each pallet. All developed experiments were carried out under the following conditions: a) Indoor temperature 20°C +/- 2°C, b) Moving speed 3m/s and c) Relative humidity 40-50%.

Figure 2. (a) Arc and antennas (b) Products (c) The experiment design

The characteristics of each of the experiments are described in Table 2. Load heights are considered: a) High, if they exceed 1,5m, b) Medium, if they are between 1 and 1,5m and c) Low, less than 1m. The nature of the load is denominated: a) Solid, if it is composed entirely of corrugated cardboard boxes wrapped with polypropylene, b) Metallic, in the case of cans wrapped with polypropylene, c) Liquid, if it is liquid, packaged both in PET (polyethylene terephthalate) as in cans, also wrapped with polypropylene.

Table 1. Equipment used

Test	Nature of the load	Type of load consolidation	Pallet height	Reading antennas
1	Solid	Homogeneous	Medium	1, 2 and 3
2	Metallic	Homogeneous	Low	1, 2 and 3
3	Metallic	Homogeneous	High	1, 2 and 3
4	Liquid	Homogeneous	Medium	1, 2 and 3
5	Metallic/Solid	Nonhomogeneous	High	1, 2 and 3
6	Liquid	Homogeneous	Medium	1, 2 and 3
7	Metallic/Solid	Nonhomogeneous	Medium	1, 2 and 3
8	Solid	Homogeneous	High	1, 2 and 3
9	Solid	Homogeneous	High	1, 2 and 3
10	Solid	Homogeneous	High	1, 2 and 3
11	Solid	Homogeneous	High	2
12	Solid	Homogeneous	High	1, 2 and 3

3. Results

Figure 3 shows the percentage of measurement according to the position of the tag in each of the trials. As can be seen, the highest levels of detection by the antennas are obtained in the third position, which in turn shows the highest percentages in metallic products, reaching reading values of 100%.

The lowest measure values were obtained at positions 4 and 5 wherein the tags were not detected in three of the experiments performed, where as in other tests the percentage of reading did not reach 20%.

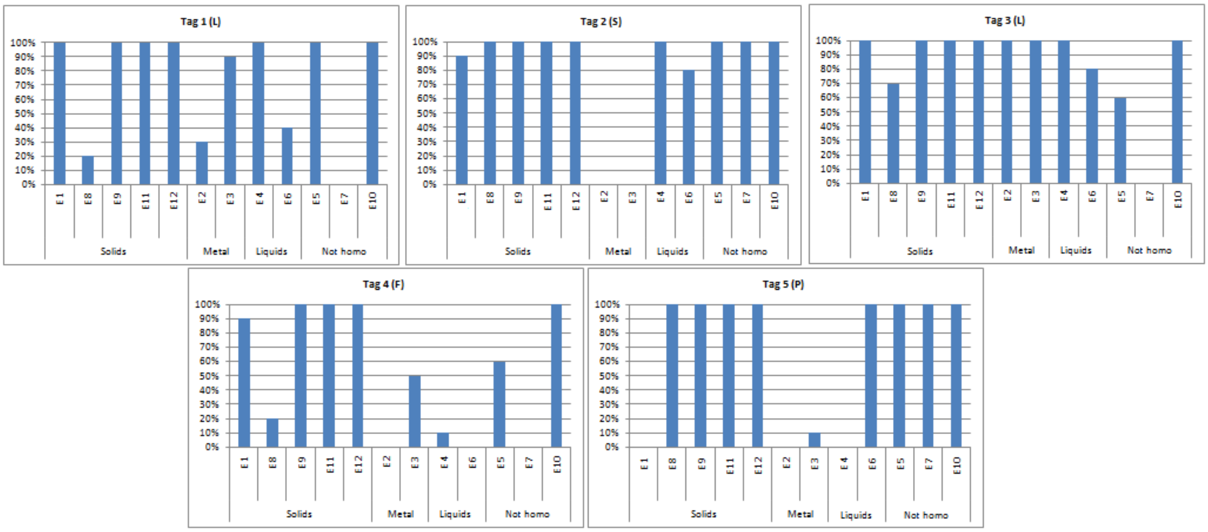

Fig. 3. Percentage of measure by tag position and nature of the load

Figure 4 provides the percentage of reading per antenna for each of the positions of the tag. Analyzing the following graphs, one can appreciate that the proximity of the tag to the antenna is critical to achieve the desired measures, as the tags located in positions 1, 2 and 3 were detected mainly by the antennas 1, 2 and 3, respectively, which were the closest to them.

In the case of tags placed on the front and rear positions (4 and 5) were mostly detected by the antenna 2, located at the top of the arch.

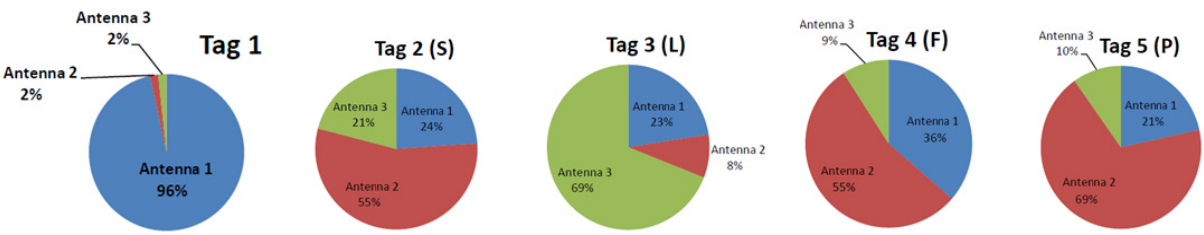

Figure 4. Percentage of measures per antenna

Figure 5 shows the percentage of global tag reading. As seen in the graph below, tags were not detected in all of the tests performed on any of the sides, which in turn is in concordance with that established in the literature, being the positions 2 and 3 which generated the highest values.

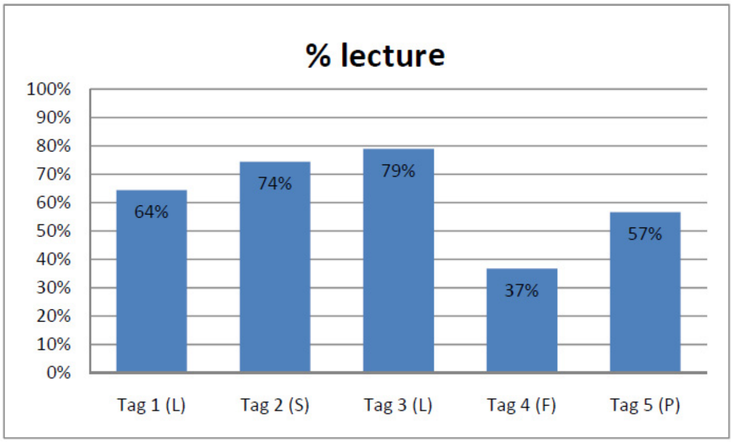

Figure 5. Average percentage of measure per position

4. Conclusions

The tests carried out showed that there is still the difficulty of implementing RFID technology in logistics operators, since none of the five positions where tags were placed reached a reading of 100%. The maximum values obtained, and therefore the most suitable places for placing the tags, were found at positions 2 and 3 corresponding to the top of the pallet load and one side, since in these arrangements the level of detection reached values of 74% and 79%, respectively.

Due to the impossibility to detect 100% of the tags placed in at least one of the set positions, it was determined the need to establish the combination that reached said reading level efficiently, which was obtained by placing tags at positions 3 and 5 and not in 2 and 3, as one might suppose since these were where levels of reading are highest.

Another important conclusion reached was that, in general, the front position is the least appropriate for placing and reading a tag, since it was in this in which the lowest detection levels were achieved.

Likewise, one can conclude that the tag located on the upper pallet generally shows good reading ratios except when transporting metallic materials. While products made of metal could not be detected properly by the antenna on top of the arch, this was not the case of tags placed on the sides of the pallet, since they were detected even at 100% by the antennas, showing the importance of the position of the tag even with materials recognized due to the difficulty they add to RFID readings.

As a result of this investigation we determined the importance of the location of the tags in order to achieve the highest levels of reading and that is why is detected the need for further investigation to establish other critical factors that help to achieve this end.

5. Aknowledgements

Melisa Olivera would like to thank CONACYT and CONCIYTEY for the Master scholarship granted.
Javier Valencia would like to thank CONACYT and CONCIYTEY for the PhD scholarship granted.

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